

The present invention is a method or an apparatus for interactively processing biological cells maintained in a sterile environment. Furthermore, the invention provides superior means for enzymatically converting red blood cells of groups A, B, or AB to group O. The described cell processing apparatus and method also provide superior means for processing other blood cells such as white blood cells, stem cells, platelets or plasma for transfusion or transplantation. The invention may also be used for separating culture fluid from micro-organisms in the production of biopharmaceuticals. In each case, the cell processing method or apparatus can adjust the processing algorithm based on the type of the processed cells or the cell amount. Furthermore, the cell processing method or apparatus assure uniform and reproducible processing conditions for the processed cells regardless of the processed cell amount.

In one aspect, an apparatus for interactively processing biological cells maintained in a sterile environment includes a supply module, a cell module, a processing module, a set of conduits, a plurality of valves, a plurality of sensors and a control module. The supply module is constructed and arranged to provide selected amounts of process chemicals. The cell module includes a cell sensor for measuring an amount of the biological cells supplied for processing to the processing module. The processing module is constructed and arranged to process said biological cells. The conduits connect the supply module, the cell module and the processing module in a sterile manner and the valves control the transfer of the biological cells and the process chemicals between the modules. The sensors are constructed and arranged to detect the transfer of the biological cells and the process chemicals. The control module is operatively connected to the valves, the sensors and the processing module. The control module also receives data from the cell sensor and controls the transfer and the processing of the biological cells based on the cell sensor data, wherein the modules are constructed and arranged to prevent unwanted contamination of the cells.

This aspect may include one or several of the following features:

The cell sensor includes a weight sensor constructed and arranged to weigh the supplied amount of the biological cells. The cell sensor includes a volume sensor constructed and arranged to measure volume of the supplied amount of biological cells.

The control module is further arranged to calculate amounts of the process chemicals based on the cell sensor data. The control module is further arranged to select an algorithm for processing of the cells based on the cell sensor data.

The supply module includes several containers constructed and arranged to hold the process chemicals, wherein at least some of them are in a liquid state. The process chemicals include an enzyme solution. The process chemicals include a saline solution.

The processing module includes a processing vessel constructed and arranged to vary its volume relative to a volume of the process chemicals and the cells transferred to the vessel for processing. The processing module may include a centrifuge. The centrifuge is constructed and arranged to vary its volume by receiving a filling fluid arranged to occupy a selected volume. The filling fluid may be an expressor fluid designed to selectively express the process chemicals or the cells during centrifugation. The processing module is constructed to agitate, heat, cool or mix the processing chemicals and the cells.

The sensors include an optical sensor, a pressure sensor, a mass flow meter, a weight sensor, a temperature sensor, a sensor, a volume sensor, a density sensor, a viscosity sensor or an electrical resistance sensor.

The interactive system may further include a pump constructed and arranged to advance the material from the supply module to the processing module inside the conduits.

The supply module may further include at least one supply sensor constructed and arranged to measure the amount of at least one of the process chemicals transferred to the processing module. The supply sensor includes a mass sensor, a mass flow meter, a volume sensor or a density sensor.

Another aspect is a method of controlling operation of a cell processing system comprising a control module, a processing module connected in a sterile manner by a set of conduits to a cell module and to a supply module that provides selected process chemicals, and several sensors providing process data to the control module. The method includes providing in the cell module biological cells; measuring an amount of the cells supplied to the processing module for processing; providing in the supply module process chemicals according to a processing algorithm; dispensing from the supply module the process chemicals to the processing module based on the measured amount of the cells; processing the cells in the processing module; and storing the processed cell while preventing unwanted contamination of the cells during the dispensing and the processing.

This method may include the following features: The dispensing from the supply module includes calculating amounts of the process chemicals based on the measured amount of the

cells. The measured amount of the cells supplied for processing may be less than the amount of the biological cells provided in the cell module.

In another aspect, a method of processing biological cells in a sterile environment includes providing biological cells; measuring an amount of the cells supplied for processing; providing process chemicals according to a processing algorithm; dispensing the process chemicals based on the measured amount of the cells; processing the cells; and storing the processed cell while preventing unwanted contamination of the cells during the dispensing and the processing.

This method may further include selecting the processing algorithm based on the provided cells.

IN THE CLAIMS:

Please cancel claims 1-8.

Please add the following claims:

9. An interactive system for processing biological cells maintained in a sterile environment, comprising:

a supply module constructed and arranged to provide selected amounts of process chemicals;

a cell module including a cell sensor constructed and arranged to measure an amount of said biological cells supplied for processing;

a processing module constructed and arranged to process said biological cells;

a set of conduits for connecting said supply module, said cell module and said processing module in a sterile manner;

several valves constructed and arranged to control transfer of said biological cells and said process chemicals between said modules;

several sensors constructed and arranged to detect said biological cells and said process chemicals; and

a control module operatively connected to said valves, said sensors and said processing module, said control module being constructed and arranged to receive data from said cell sensor and control said transfer and said processing of said biological cells based on said cell sensor data;

wherein said modules are constructed and arranged to prevent unwanted contamination of said cells during said processing.